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Smart Product Recommendations for E-Commerce

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Abstract: ***Over the past decade, internet usage has grown rapidly, creating opportunities for various online businesses to expand. One of the most significant areas of growth is e-commerce. As more people shop online, recommendation systems have become essential. These systems personalize the user experience, help customers find products quickly, and boost sales for businesses. However, building an effective recommendation system comes with challenges, especially when handling large amounts of data. A recommendation system suggests products to users based on their interests. It identifies the right items by analyzing past purchases, browsing history, and product details. Many recommendation systems generate long lists of suggested items, ranking them based on predicted user preferences. Recommendations can be based on factors like price, location, wish-listed items, cart history, search history, and past purchases. A well-designed recommendation system improves customer satisfaction, increases sales, and enhances user engagement. This research will develop to create a recommendation system for both new and existing users. It will use Neighborhood-Based Collaborative Filtering to suggest products based on user ratings and past purchases. Additionally, the system will remove duplicate ratings to provide more accurate and relevant recommendations based on user interests.***

Keywords: E- Commerce, recommendations, sales, products, ratings, purchases.

I. INTRODUCTION

E - Commerce Recommendation systems will recommend the products to the users based on the ratings and past purchases, cart items and search history of the users. Product recommendation systems are a key part of many e-commerce websites and applications. They use data about what customers have bought or viewed in the past to make recommendations for what they might want to buy or view in the future.This system provides relevant suggestions to the user as per his/her interest and need. Recommendation systems face challenges such as handling large datasets, ensuring accurate predictions, and avoiding redundant recommendations. To recommend products based on both a user's direct input and browsing behavior, it is important to understand their preferences using various data analysis techniques. Researchers are continuously working on improving recommendation methods by analyzing a user's past choices, feedback on recommendations, and similarities between users. As a result, efforts to enhance recommendation system performance are ongoing and expanding. By analyzing collected data, the system must filter product information to suggest items that best match a user's interests and needs. The recommendation system model is designed to perform this filtering process. Over time, researchers have improved existing models by addressing their limitations and making them more effective. To address these issues, this research proposes a Neighborhood-Based Collaborative Filtering approach that provides personalized recommendations based on user ratings and purchase history. Additionally, the system will eliminate duplicate rating values to improve accuracy and ensure relevant suggestions.

II. LITERATURE REVIEW

With the rise of e-commerce websites, finding the right product at a reasonable price has become challenging for users due to the vast number of available options. As a result, consumers often have to search multiple websites individually to find the best product. To address this issue, a study [1] proposed a system that simplifies product selection by providing real-time results, helping users save time. This system is designed to streamline the long and tedious search process, ensuring users receive quick and efficient recommendations.

To improve recommendations based on user-generated content, Z. Wang et al. [2] suggested integrating social networks with information-sharing networks. Their system recommends videos that users are most likely to watch or purchase on social media platforms. It uses an updated user-content matrix to predict how videos might be shared or imported. By analyzing social interactions, user activity, and content similarity, the study demonstrated that combining social and content-based recommendations significantly improves accuracy compared to traditional filtering techniques.

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Brent Smith et al. [3] highlighted how Amazon.com developed its collaborative item-based filtering system in 1998. Unlike traditional methods, this system does not rely on user history, making it effective even for new or infrequent customers. By analyzing user behavior and current activity, Amazon was able to suggest relevant products, ultimately increasing sales, even for non-media items.

Another study [4] aimed to improve recommendation accuracy by considering social networks' influence on user preferences. The authors proposed a method that incorporates ratings, reviews, and social connections. They used the LR model to predict ratings, CoDA to identify user communities, and Word2Vec to convert text reviews into numerical data. The study compared this approach with traditional matrix factorization and neighborhood.

III.IMPLEMENTATION

The proposed recommendation system aims to enhance the online shopping experience by providing personalized product suggestions based on user behavior and preferences. It uses Neighborhood-Based Collaborative Filtering to analyze user interactions and generate relevant recommendations. This method ensures that both new and existing users receive accurate product suggestions, improving customer satisfaction and increasing sales. The system extracts key user preferences and item characteristics to identify patterns and correlations between different users and products.

Neighborhood-Based Collaborative Filtering (CF) is a recommendation algorithm that predicts a user's preferences by analyzing the preferences of similar users (user-based CF) or similar items (item-based CF). It operates on the assumption that users with similar past behaviors will have similar future preferences. Neighborhood-based recommendation systems suggest products by finding similar users or similar items based on past interactions. The main idea is:

- Users with similar interests often like the same products.
- Similar products usually get similar ratings from the same user.

1) Step 1: Data Collection

The system collects historical user interactions, including:

- User-Item Ratings Matrix: Records of product ratings given by users.
- Implicit Feedback: Clicks, wishlist, cart additions, and purchase history

2) Step 2: Finding Similarity

To find similar users or items, similarity is calculated using:

- Cosine Similarity

$$\text{Similarity } (A, B) = A.B \,/\, \|A\|.\|B\|$$

- Pearson Correlation Coefficient (PCC)

$$\text{Similarity}(A, B) = \sum(rA - \bar{rA})(rB - \bar{rB}) \,/\, \sum(rA - \bar{rA})2 \cdot \sum(rB - \bar{rB})2 \sum(rA - \bar{rA})$$

3) Step 3: Finding Nearest Neighbors

- Selects N most similar users or items based on similarity scores.
- For User-Based CF, finds users with similar purchase history.
- For Item-Based CF, finds products frequently bought together.

4) Step 4: Predicting Missing Ratings

Predictions are made using weighted averages from similar users/items:

$$r\hat{}ui = \bar{ru} + \sum v \in N(u)(Suv \cdot (rvi - \bar{rv})) \,/\, \sum |suv|$$

5) Step 5: Generating Recommendations

Based on the trained model, the system ranks and suggests personalized products for each user. The recommendations are displayed in different sections, such as:

- For User-Based CF: Suggests products liked by similar users.
- For Item-Based CF: Suggests similar items based on previous purchases.

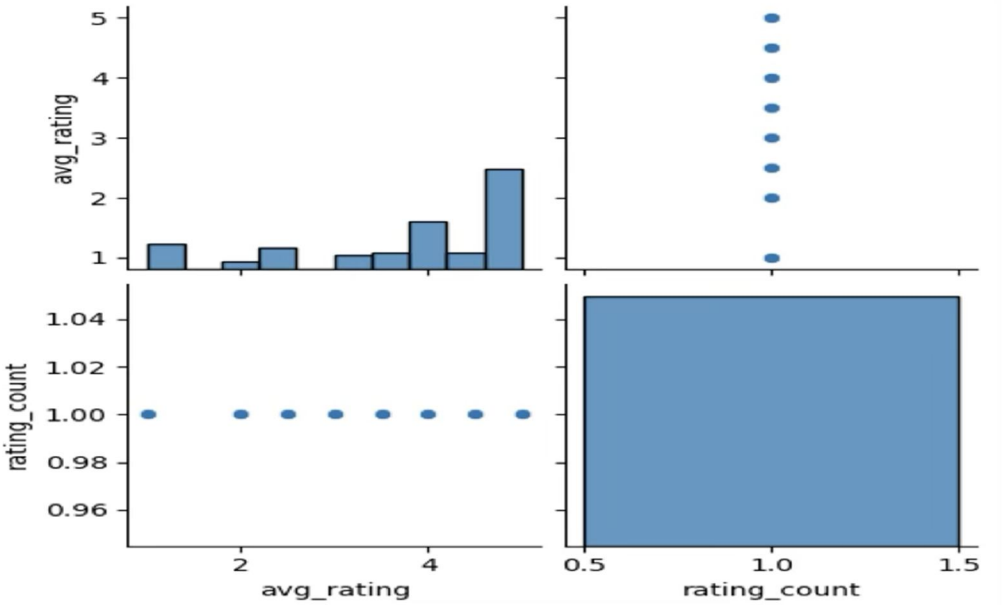
A. Advantages

1) Provides personalized recommendations for both new and existing users
2) Eliminates redundant data, improving recommendation accuracy
3) Enhances customer engagement and satisfaction
4) Adapts dynamically to user behavior changes

Neighborhood-based collaborative filtering provides an accurate, interpretable, and scalable approach for product recommendations in e-commerce. It enhances user experience and boosts sales by identifying patterns in user behavior and product similarities.

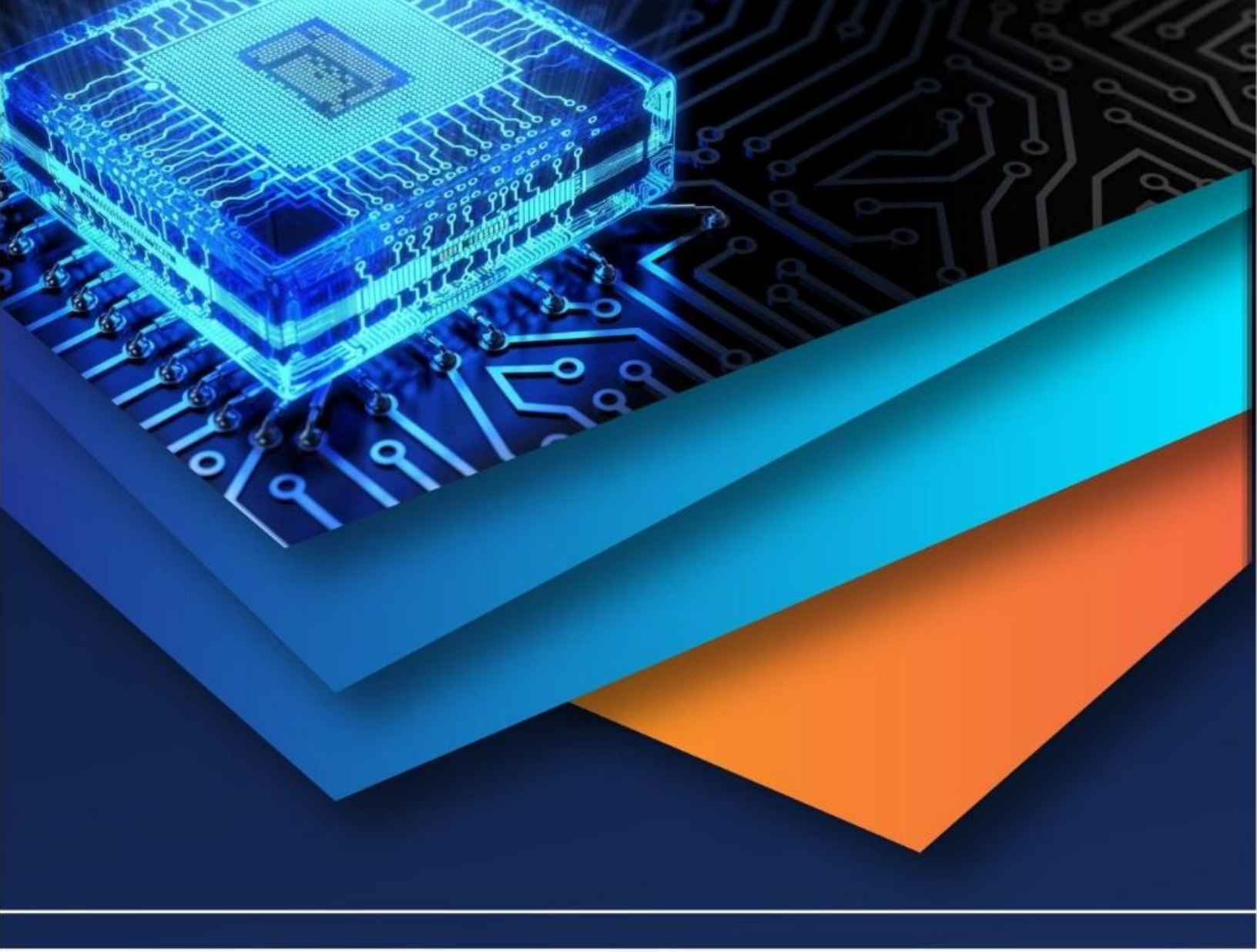
IV. RESULTS

StockCode	avg_rating	rating_count
AZYNQZ94U6VDB	5.0	1
A22JDDJB1ZLGGZ	5.0	1
A233AWZLS4LDYO	5.0	1
A23A7OH3AM0PDA	5.0	1
A3HGP1YI7G80HA	5.0	1
A3E7PG9CHDBICA	5.0	1
A3CK3T0E4C99CJ	5.0	1
A3BY5KCNQZXV5U	5.0	1
A3BMUBUC1N77U8	5.0	1
A253JJFXQNPCOJ	5.0	1
A25DO9Q43GE6WK	5.0	1
A25EIC1CXMA1DO	5.0	1
A3A5LQ5T7M7I8V	5.0	1
A262D8GC5XRU31	5.0	1
A36VF2I8ILFJH1	5.0	1
A36JCYNJG4Q2W6	5.0	1
A36B6D7RXI94JR	5.0	1
A35QI2GKW8K230	5.0	1
A26FS7F997E7SI	5.0	1
A3HGTTFIDLCWDJ	5.0	1



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